Space Weather Technical Forecast

Issued on Sunday, 10 April 2022 at 01:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Risk of G1/Minor Storm, mainly on Days 1 and 4 (10 and 13 Apr). Slight chance of G2/Moderate Storm on Day 1. Chance of Active fluence on Days 2 and 3 (11-12 Apr).

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low over the past 24 hours, with several mostly minor C-flares from AR2978. There are now two sunspot regions on the Earth-facing disc, as AR2978 and AR2981 have both rotated off the southwest limb. The remaining two regions are both small and simple. A large filament in the southwest of the disc lifted off around 09/0830 UTC. The associated CME is still being analysed, with the bulk of the ejecta travelling below Earth's orbit, but it may have an Earth directed component.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was indicative of weak CME effects and a possible HSS arrival late in the period. Wind speeds were mostly slow-ambient, rising from 09/2100 UTC to around 440 km/s. The density was average to start, reaching mainly above average from 09/0415 UTC, peaking at 42 ppcc at 09/1245 UTC. The interplanetary magnetic field (IMF) strength, Bt, was Weak to Moderate, becoming Strong at 16 nT just before 10/0000 UTC. The north-south component, Bz, ranged between +14/-11 nT, and was mostly southward directed until 09/1630 UTC, when it became largely northward directed. The Phi angle started the period negative (towards the Sun), becoming variable between 09/0645-1245 UTC, after which it settled positive, before switching back to negative at 09/2320 UTC. Geomagnetic activity was Quiet to Active (Kp 1-4).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) measured at GOES-16 at GEO was at background levels. The high energy (greater than 2MeV) electron flux was mostly at normal background, peaking briefly at moderate levels. The corresponding 24-hour fluence was on a slight increasing trend, with 5.24e6 integrated pfu observed at 10/0000 UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be Low or Very Low, with only small and simple sunspots on the disc. There is a Chance for further C-class flares during Day 1 (10 Apr), which will decline as AR2978 rotates further away from the southwest limb.

Solar Wind / Geomagnetic Activity: Current weak CME effects may be further enhanced by another CME arrival during Day 1 (10 Apr). There is also a negative polarity equatorial coronal hole, CH72/CH73, which is expected to give a HSS at Earth during Day 1. Timing of both of these features is uncertain, but combined CME and HSS effects are expected to dominate during Day 1, slowly starting to ease during Days 2 and 3 (11-12 Apr). A further CME is possible on Day 4 (13 Apr), but timings are currently uncertain as Enlil modelling is not yet available. Geomagnetic activity is forecast to be Quiet to Active with G1/Minor Storms likely and a slight chance of G2/Moderate Storms. Risk of G1 gradually declining through Days 2 and 3, before increasing again on Day 4 with a further possible CME arrival.

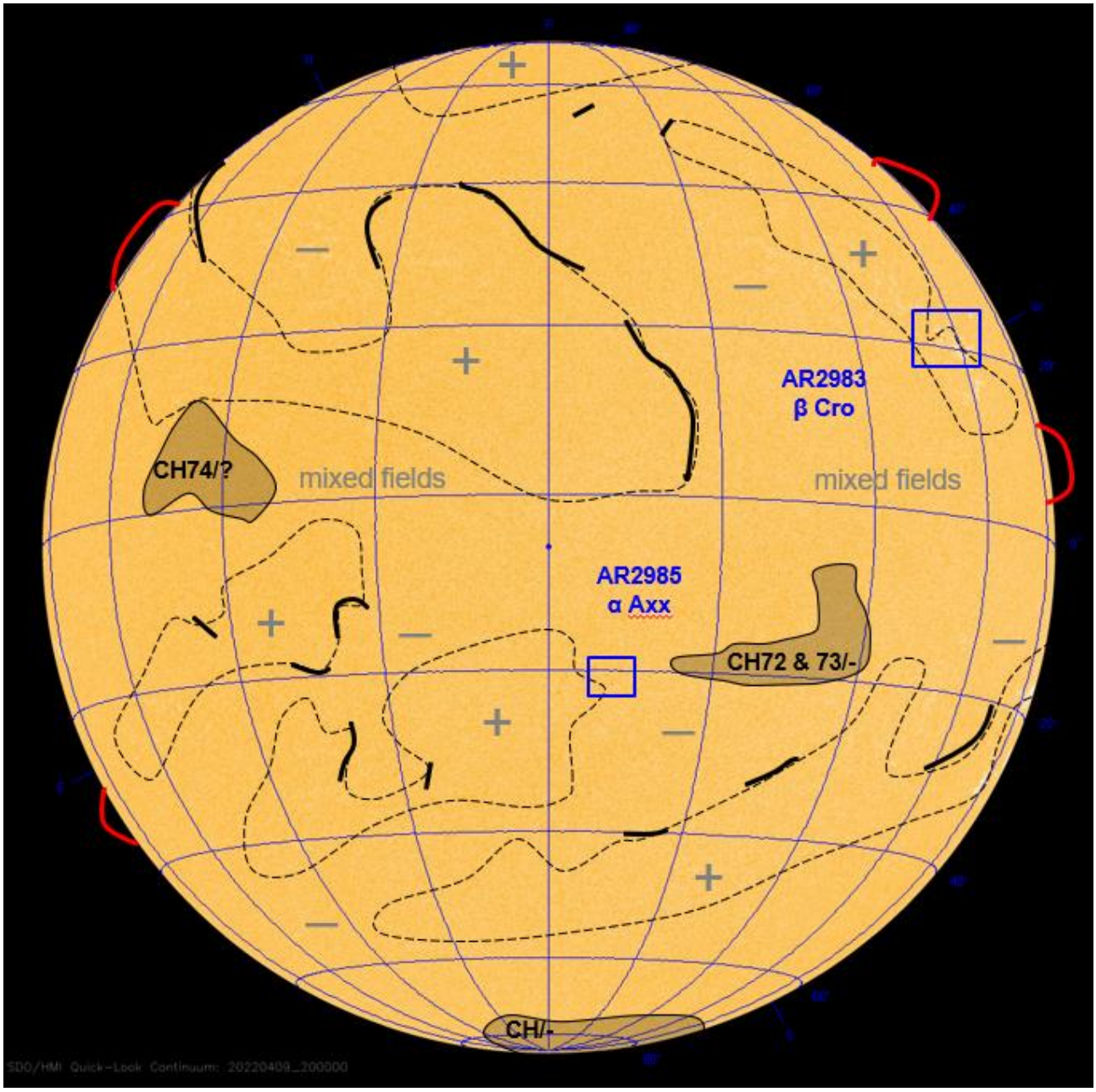
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Met Office Space Weather Technical Forecast

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to persist at background levels. The high energy (greater than 2 MeV) electron flux is forecast to start at background to moderate levels, perhaps rising to peak at High levels on Days 2 and 3 (11-12 Apr), before a further CME arrival is likely to suppress levels once again. The associated 24 hour fluence is likely to remain below the Active threshold but with a chance of rising above on Days 2 and 3.

Figure 1. Solar Analysis Valid 09/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Geomagnetic Storms:

Solar winds at Earth have been indicative of weak CME effects over the last day or so. A further CME from a filament eruption on the 7th is anticipated to pass close to Earth on Day 1 (10 Apr), possibly later in the day. There is also a HSS from the negative polarity equatorial coronal hole, CH72/CH73, which was expected to arrive during Day 1 (10 Apr), but may actually have started to arrive recently. Timing of both of these features is uncertain, but either way combined CME and HSS effects are expected to dominate during Day 1, slowly starting to ease during Days 2 and 3 (11-12 Apr).

After this, a further CME is possible from a filament lift off which occurred around 09/0830 UTC. Imagery is still being analysed, but an Earth directed component is considered possible. As such, a CME arrival is possible on Day 4 (13 Apr), but timings are currently uncertain as Enlil modelling is not yet available.

Geomagnetic activity is forecast to be Quiet to Active with G1/Minor Storms likely and a slight chance of G2/Moderate Storms. Risk of G1 gradually declining through Days 2 and 3, before increasing again on Day 4 with a further possible CME arrival.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	60	20	5	40
Strong	G3	No	2	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

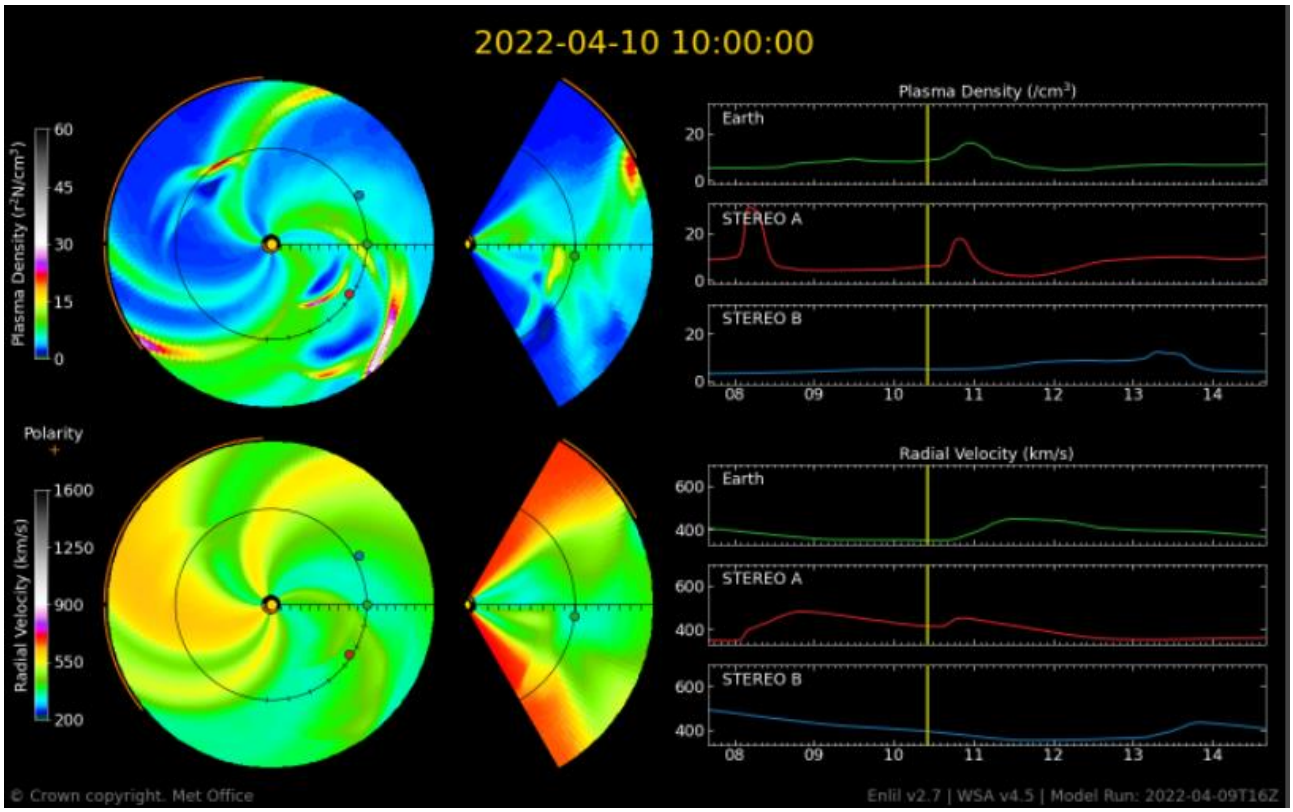
Geomagnetic Activity - Earthbound Coronal Mass Ejections

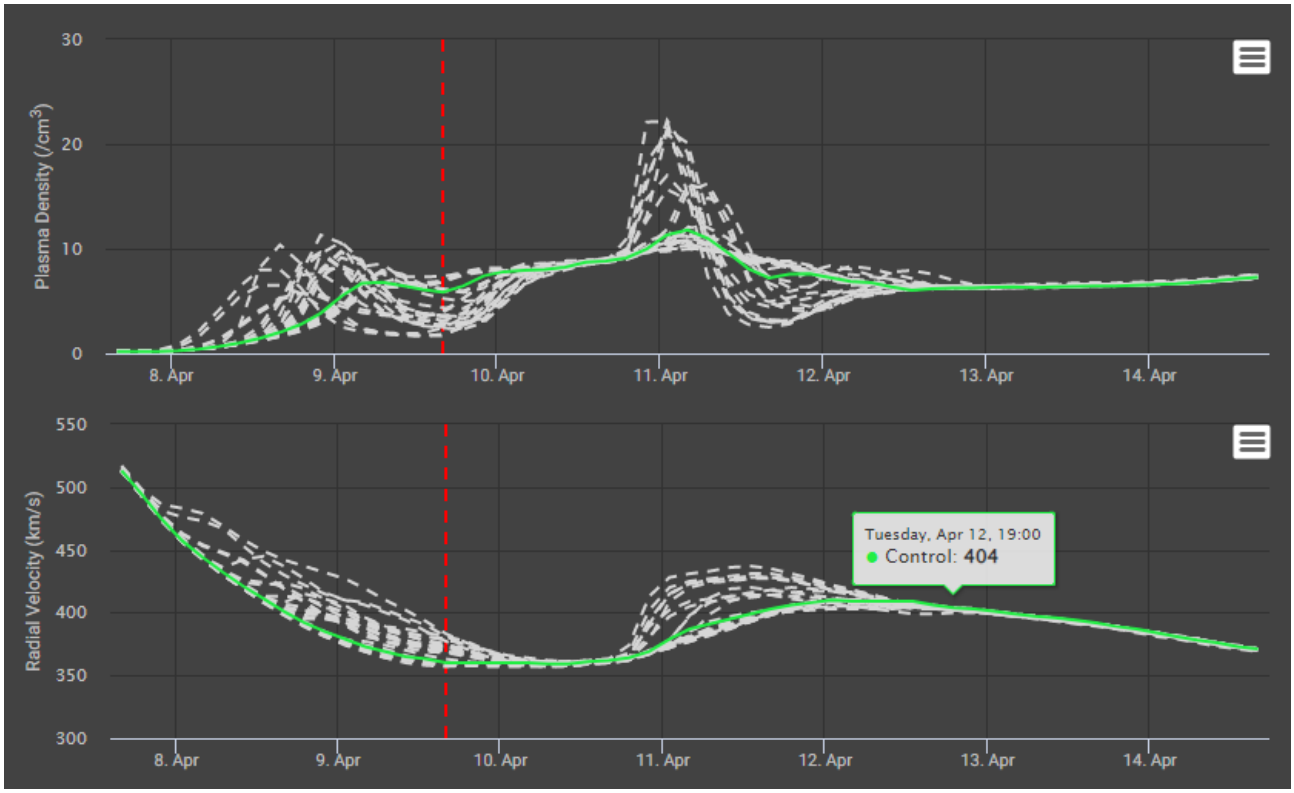
Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
07/1317	Partial	Filament eruption	S26 E32	416	N/A	Likely to miss, but low chance glancing blow late on 10th

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 2: Enlil model and ensemble showing possible CME arrival late on 10 April





Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Radio Blackouts - X-Ray Flares:

There are now two sunspot regions on the Earth-facing disc, and these are relatively simple and inactive. Recent C-class activity mainly came from AR2978 which has now rotated over the southwest limb, along with AR2981. AR2978 will, however, contribute to the flare probability until it is well over the limb. The remaining regions are AR2983 (Cro/Beta) and AR2985 (Axx/Alpha) - both are small and simple with low flare risks.

Overall, activity has been Low, with a few mostly minor C-flares, largely from AR2978. Low activity is expected to become Very Low as AR2978 rotates further off the disc. One further possible region may rotate onto the southeast limb in the coming days, but it doesn't currently look particularly active in STEREO-A imagery.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	3	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background and in the absence of complex sunspots on the Earth-facing disc is expected to remain at this level.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

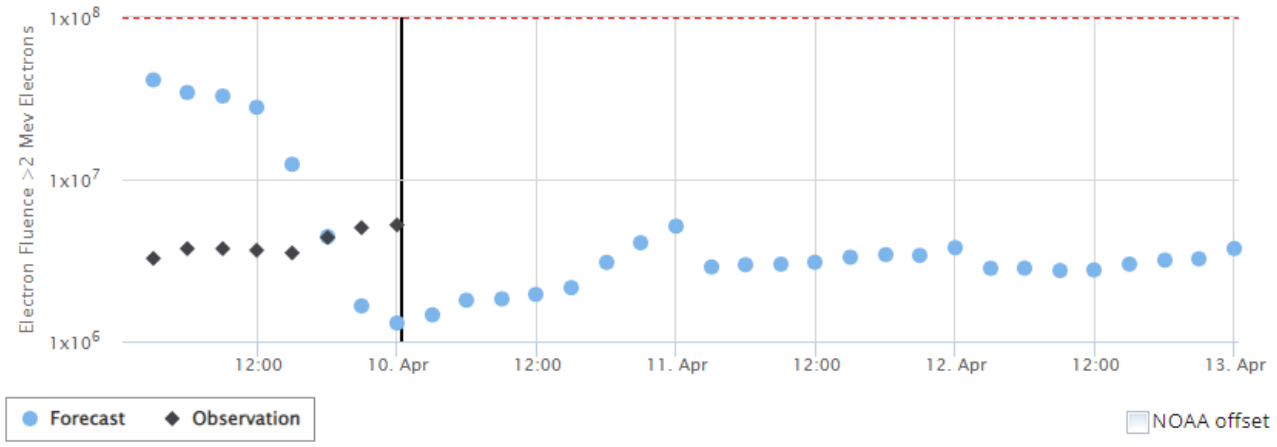
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2MeV), as observed by GOES-16 at GEO, has been mainly at normal background levels through the last 24 hours. Recent CME arrivals and a likely HSS arrival is expected to keep flux levels suppressed at first, before a possible rise through Days 2 and 3 (11-12 Apr) in response to the HSS. Flux may peak at High levels during this time, before a further possible CME arrival on Day 4 (13 Apr) may suppress flux levels once again. The associated 24 hour fluence is below the Active (1e8 integrated pfu) threshold and is likely to remain below through the forecast period, although a rising trend is possible on Days 2 and 3. A decline is then likely on Day 4 in response to possible CME effects. REFM will not be taking account of CME effects, or the HSS as this is a non-recurrent feature, and as such is unlikely to be giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	20	30	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: REFM is showing a steady trend well below the Active threshold. However, it is unlikely to be giving good guidance with a rising trend possible into Days 2 and 3.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.